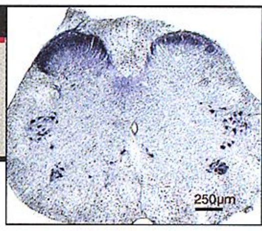
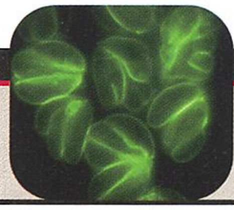


PAGE 521
Early pain leaves its mark



525
Toxoplasma and behavior control

EMERGING DISEASES

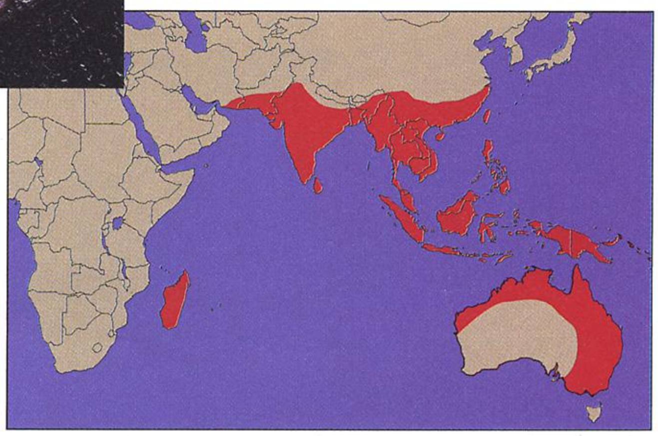
Malaysian Researchers Trace Nipah Virus Outbreak to Bats

ATLANTA—Scientists are a step closer to unraveling a medical mystery that killed 105 people in Malaysia last year and destroyed the country's pig industry. The Nipah virus, which caused the disease, most likely originated in a native fruit bat species, Malaysian researchers reported here at a meeting* last week. They say the findings will help Malaysian health authorities prevent future outbreaks of the Nipah virus. Others see the case as an argument for expanding research into infections that can leap the boundary between animals and humans.

The Nipah virus study highlights the enormous potential of the animal world to produce new human pathogens—the threat of "emerging diseases" that increasingly concerns researchers and public health experts. Three out of every four recent emerging diseases arose from animal infections or zoonoses, according to another study presented at the meeting. And most researchers agree that rather than scramble to identify the source of such outbreaks after they happen, it makes sense to try to survey and understand the plethora of unknown viruses in wildlife before a crisis strikes. "The emphasis in emerging diseases should be in the field," says Durland Fish, a medical entomologist at Yale University. "As it is now, we wait until we have an epidemic of some new zoonotic pathogen and then try to figure out what it is and why it occurred."

The Nipah outbreak, virologists say, followed a classical pattern of havoc and panic. In late 1998 and early 1999, hundreds of pig industry workers in Malaysia—as well as 11 employees of a Singaporean slaughterhouse—came down with a severe form of encephalitis that killed about 40% of the patients. Malaysian health authorities initially mistook the outbreak for Japanese encephalitis, a similar brain infection caused by a fairly common virus. But a team from the University of Malaya in Kuala Lumpur and the Centers for Disease Control and Prevention in Atlanta eventually identified the previously unknown Nipah virus as the culprit (*Science*, 16 April 1999, p. 407).

Nipah, named after the town in Malaysia where the first known victim lived, closely resembles a virus called Hendra, which had killed over a dozen horses and two people in Australia in 1994 and 1995. Both belong to a virus family called the Paramyxoviridae. Australian researchers had already shown the Hendra virus to be widespread among three *Pteropus* bats, which feed on fruit and nectar. These furry creatures, commonly known as flying foxes, are not made ill by the Hendra virus. Nor do people who handle the animals get infected. But researchers suspect that when horses ingest bat urine or placental fluid, they act as "amplifying hosts," vastly increasing the number of infectious viral particles, which puts humans at risk.



Deep reservoir. Nipah virus has been traced to the island flying fox (*inset*), one of many *Pteropus* species found in India, Southeast Asia, and Australia.

CREDITS: (LEFT TO RIGHT) MERLIN D. TUTTLE/BAT CONSERVATION INTERNATIONAL; J. MACKENZIE

Suspecting that something similar might be going on with Nipah, researchers last year turned their attention to fruit bats living in a cave close to affected pig farms. They found that two native species—the island flying fox and the Malayan flying fox—carried antibodies to the Nipah virus. But these may have been just infected bystanders. To prove that the bats were a reservoir, researchers had to show that the animals carried live virus.

This year, a team led by the University of Malaya's Lam Kai Sit studied a large bat colony on Tioman Island, off the Eastern coast of peninsular Malaysia. They collected urine by laying large sheets of plastic on the ground near the bats' roost. After taking over 1000 samples, they detected the virus in the urine of one animal of the species called island flying fox, Lam told the meeting. In addition, they found live virus in a piece of fruit that had been munched on by a bat, suggesting that the virus was also present in the animal's saliva.

The results prove that the island flying fox is a Nipah reservoir, says Lam. Pigs probably became infected when they ingested bat urine or saliva, perhaps by scavenging half-eaten fruit dropped from a tree, and they became an amplifying host. That's not an unlikely scenario, says Lam, because many Malaysian pig farms have fruit trees. The finding may be key to preventing future outbreaks, says Lam: "We can now encourage pig farmers not to grow any fruit trees in and around the farm." (Because there aren't any pig farms on Tioman Island, the bat colony there probably doesn't pose a risk, says Lam.)

The Malaysian work has added a small piece to a large puzzle involving flying foxes, which occur in a broad belt from Australia to India. Researchers suspect that the animals harbor many Paramyxoviridae. In 1997, Peter Kirkland of the Elizabeth Macarthur Agricultural Institute in Camden, Australia, and his colleagues discovered that several flying foxes carried a virus called Menangle, which also infects pigs, causing fetal deformities and stillbirths. During their search for the Nipah reservoir, Lam and his colleagues discovered a virus closely resembling Menangle, which they called Tioman, as well as a third one, which they haven't characterized yet.

Indeed, every flying fox species may carry its own members of the Paramyxoviridae

* International Conference on Emerging Infectious Diseases, 16 to 19 July, Atlanta.

family, says John Mackenzie, a virologist at the University of Queensland in Australia. At this point, no one knows how many cause disease in humans and animals. But scientists have embarked on a broad study of many bat species. Mackenzie, for instance, has already found antibodies to the Hendra virus in bats from New Guinea, and he's now trying to obtain bat sera from Indonesia, Laos, and India, while others are planning a hunt in Cambodia. "If there are X viruses in bats, let's find them all," says Mackenzie. "If you know what's out there, it's much easier to diagnose and understand what's happening next time there is an outbreak."

The rise of such animal-borne diseases is not unusual, according to a study presented at the meeting by Mark Woolhouse of the University of Edinburgh in the United Kingdom. Woolhouse and his colleagues spent several months "trawling through the textbooks" to prove the common notion that most emerging diseases are zoonoses. They found that humanity is currently plagued by 1709 known pathogens (from viruses and bacteria to fungi, protozoa, and worms). The team concluded that 832 of those, or 49%, are zoonotic. But among the 156 diseases that are considered "emerging," 114 were zoonoses—a stunning 73%.

The bottom line? Zoonoses are three times more likely to be emerging than nonzoonotic diseases, and researchers should keep an especially wary eye on animal pathogens, says Woolhouse. Many more dangers may be lurking in the animal kingdom.

–MARTIN ENSERINK

ELECTRONIC OPTICS

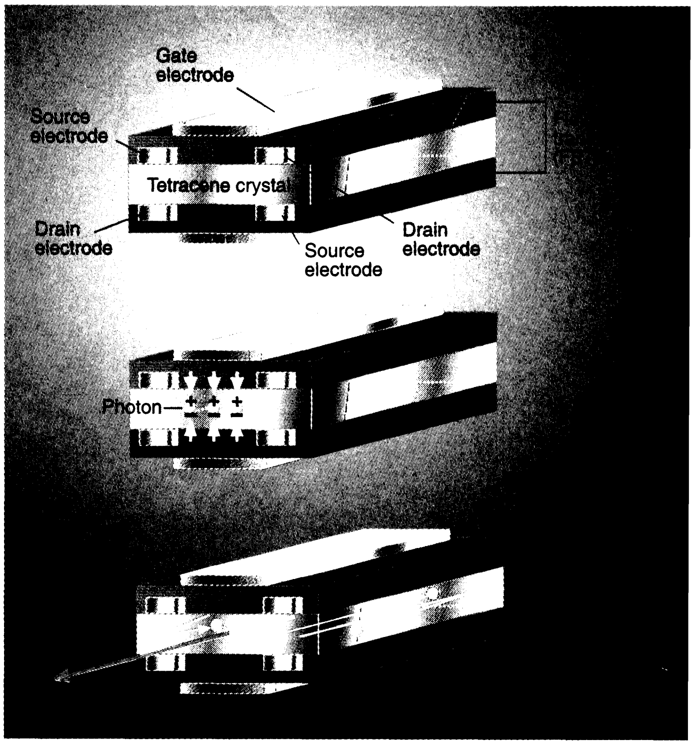
Organic Lasers Promise New Lease on Light

Tiny solid state lasers are big business: Almost \$500 million worth of the devices are sold each year for uses ranging from compact disc players to telecommunications equipment. But they have big drawbacks: Many of today's lasers are made from ceramic chips—similar to those at the heart of computer processors—that require expensive clean-room facilities to manufacture, and their color palette is somewhat limited. Researchers have long pinned their hopes on organic materials, which are typically easier and cheaper to process. But to date they have managed to coax organic solids to lase only when blasted with a beam from another laser—hardly a commercial advantage. Now, however, organics have finally begun to shine on their own.

On page 599, a team at Lucent Technologies' Bell Laboratories in Murray Hill, New Jersey, reports that they've devised the first electrically powered solid state organic laser, a step that could open the floodgates for novel lasers that are cheaper and that shine in colors inorganics can't match. The feat is "big news," says Yang Yang, an optics researcher at the University of California, Los Angeles. "This is really a milestone. People have tried to make organic electrically pumped lasers for a long time."

To work as lasers, solid materials must function something like an interstate freeway: They must allow lots of traffic—photons in this case—to speed along without hitting potholes, and they must have plenty of on-ramps for electrical charges to get into the device. In conventional ceramic lasers, the on-ramps are metal electrodes placed above and below a semiconductor crystal. When a voltage is applied between the electrodes, electrons flow into one side of the crystal and out the other. The electron vacancies left behind, called "holes," act like positive charges that can move through the material as an electron on a nearby molecule jumps into the hole, leaving a vacancy where it originated. When electrons coming from one side of the device meet holes coming from the other, they annihilate one another, creating photons in the process. The photons bounce back and forth between mirrors on opposite sides of the crystal, prompting the crystal to release additional photons of the same wavelength. This creates a surge of light, some of which escapes in a beam through a predesigned leak in one of the mirrors.

Ceramics such as gallium arsenide chips make great lasers because, like a good freeway, they are clean and fast and have easy-access on-ramps. Solid organics, on the other hand, have been more like old country roads: Defects in the materials act like hazardous potholes, trapping photons and causing them to dissipate their energy as heat. And even high-quality organic materials have had big trouble with their on-ramps: Conventional metal electrodes are just too slow at injecting electrons and holes into organics.



Beaming. Transistor "gate" electrodes on top and bottom cause electrical charges to flow between the two additional pairs of electrodes (top). A voltage applied between transistors then causes these charges to enter the middle layer, where they produce photons (center) that generate a laser beam (bottom).

The Bell Labs group—physicists J. Hendrik Schön, Ananth Dodabalapur, and Bertram Batlogg, along with materials scientist Christian Kloc—tackled those two problems in turn. Initially, Kloc used a specialized gas furnace to grow high-purity crystals of tetracene, a molecule that consists of four linked rings of carbon atoms. That gave the researchers the multilane, high-speed freeway they needed for the photons. For their on-ramps, the team did away with the standard electrodes and turned to a pair of transistors, known as field-effect transistors, or FETs. FETs work by applying a voltage to one electrode, called a "gate," that triggers a flood of electrical charges to flow through a channel between two additional electrodes. Depending on the makeup

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